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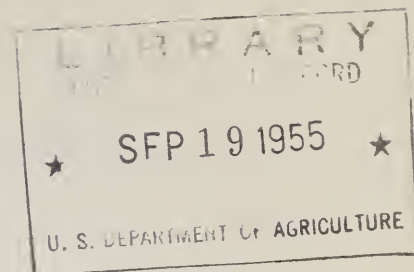
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THE DEVELOPMENT OF THE FLORA AND FAUNA IN  
THE RUMEN OF GROWING CALVES<sup>1/</sup>

by

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This study was made to determine the kinds of microorganisms in the rumen of young calves and to determine the age at which the flora and fauna typical of the mature cow become established.

The calves were taken from the dams within 24 hr. after birth and placed in individual pens with straw bedding. After about 30 days, they were placed in pens with other calves and, after 13 weeks, they were moved to a barn where they had direct contact with mature animals. Whole milk was fed until the calves were 60 days of age. After ten days of age, they were given free access to alfalfa hay and a grain mixture (15.4% crude protein). Rumen contents from one Holstein and two Jersey calves were collected by stomach tube when the animals were about 1, 3, 6, 9 and 13 weeks of age.

Data in Table 1 show a definite sequence in the establishment of the different kinds of protozoa. The rumen contained the small flagellates when calves were 1 week of age but did not contain other protozoa until after 13 weeks of age. A study of older calves raised under similar conditions showed Entodinia to be present after 17-20 weeks; Diplodinia, after 27-28 weeks and holotrichs, after 33-37 weeks.

Data in Table 2 show that total anaerobic counts were somewhat higher in calves than in mature animals. As in the mature animal the rumen fluid medium supported larger numbers of organisms than the trypticase soy medium except in calves at three weeks of age. Strict anaerobes were more numerous than organisms able to grow under aerobic conditions. However, the latter organisms were more numerous in the calves than in adult animals and were present in higher numbers in the calves at 1 to 3 weeks of age than in older calves. A rather surprising fact was that cellulolytic bacteria were present in numbers of about 1 million per ml. of rumen contents in week-old calves and were present in 3 week-old calves in numbers of about the same magnitude as in the mature animal. Lactate fermenters were much higher in numbers in calves 1 to 3 weeks of age but dropped to the level found in the mature animal after 9-13 weeks.

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<sup>1/</sup> Paper presented at the annual meeting of the American Dairy Science Association, Michigan State College, East Lansing, Michigan, June 20-23, 1955.



Table 1.-Direct microscopic observations on the protozoa present in the rumen of calves of different ages.

Number of calves	Weeks of age	Kinds of Protozoa			
		Flagellates	Entodinia	Diplodinia	Holotrichs
3	1	+	-	-	-
2	3	+	-	-	-
1	3	-	-	-	-
3	6	+	-	-	-
3	9	+	-	-	-
2	13	+	-	-	-
1	17 <sup>1/</sup>	+	+	-	-
2	20	+	+	-	-
1	27	+	+	+	-
1	28	+	+	+	-
1	33	+	+	+	+
1	37	+	+	+	+

<sup>1/</sup> Calves were placed in direct contact with mature animals after 13 weeks of age.

Table 2.-Counts of bacteria obtained from rumen contents of calves and a mature cow using various media.

		Bacterial Count Per Ml.				
Calves		"Total" Anaerobes	"Total" Aerobes	Cellulose Digesters	Lactate Fermenters	
Age (weeks)	No.	RGCA <sup>1/</sup> (000,000,000)	TS <sup>2/</sup> (000,000,000)	TS <sup>3/</sup> (000,000)	MPN <sup>4/</sup> (000,000)	Fermenters <sup>5/</sup> (000,000)
1	3	3.7 ± 2.2	2.4 ± 1.4	650 ± 440	1.2 ± 1.1	680 ± 510
3	3	3.3 ± 2.2	3.4 ± 2.2	150 ± 127	110 ± 82	310 ± 132
6	3	1.8 ± 0.3	1.5 ± 0.2	65 ± 48	320 ± 200	57 ± 18
9	3	2.9 ± 0.8	1.4 ± 0.7	35 ± 21	430 ± 190	27 ± 14
13	2	3.2 ± 1.2	1.4 ± 0.5	46 ± 10	62 ± 44	5.5 ± 0
Adult	4	1.0 ± 0.58	0.37 ± 0.12	5.9 ± 0.80	100 ± 40	17 ± 5.1

<sup>1/</sup> Rumen fluid glucose cellobiose agar.

<sup>2/</sup> Trypticase soy glucose agar with a carbonic acid-bicarbonate buffer.

<sup>3/</sup> Trypticase soy glucose agar.

<sup>4/</sup> Rumen fluid cellulose liquid medium.

<sup>5/</sup> A differential count obtained by counting colonies which developed to a larger size in an anaerobic yeast extract peptone lactate agar than in the same medium minus lactate (Gutierrez, 1953, J. Bacteriol., 66, 123).

Data presented in Table 3, show that the predominant kinds of bacteria in week-old calves were, for the most part, different from the predominant organisms in mature animals. Of the kinds commonly found in mature animals, the motile curved rods were first isolated from a week-old calf. Cellulolytic cocci were found in a 3 week-old calf and cellulolytic rods (*B. succinogenes*) and gram negative rods typical of mature animals were first found in 6 week-old calves. Three and six week-old calves contained several kinds of bacteria not predominant in week-old calves or adult animals. The predominant organisms in 9 and 13 week-old calves were similar to those of mature animals except for a gram positive rod.

These studies indicate that under the relatively isolated conditions of raising nutrition herd calves at Beltsville, many of the kinds of bacteria typical of mature animals become established in very young calves. The establishment of the full complement of protozoa is delayed until calves are older and in direct contact with mature animals.

Table 3.-Some representative predominant bacteria isolated from anaerobic rumen fluid glucose cellobiose agar and/or anaerobic trypticase soy glucose agar inoculated with rumen contents of calves of different ages.

Calf Age (weeks)	Number of Strains Isolated													
	851	1050	1052	851	1050	1052	851	1050	1052	851	1050	1052	851	1050
	1	1	1	3	3	3	6	6	6	9	9	9	13	13
Groups of bacteria	:		:		:		:		:		:		:	
(1) <u>Streptococci</u>	:	8	:		5	:		1	:		:		:	
(2) <u>Anerobic coccus I</u>	:	8	3	:		:		:		:		:		
(3) " " II	:		:		4	2	1	:		:		:		
(4) " " III	:		:	1	2	:		7	:		:		:	
(5) Gram + rod I	:	3	1	:		:		:		:		:		
(6) " " " IV	:		:		:	1		6	1	:		:	2	1
(7) " " " VI	:		:	16	5	3	1	:		:		:		
(8) Gram - rod I	:	9	16	5	3	4	:		:		:		:	
(9) " " " IV	:		5	1	3	:		:		:		:		
(10) <u>Anerobic coccus IV*</u>	:		:	:	:	3	:	4	:		:	1	:	
(11) Gram - rod (R-GXCS)*	:		:	:	:	3	1	1	:		:	6	2	
(12) <u>B. succinogenes*</u>	:		:	:	:	1	:	:		:	1	:	1	
(13) Cellulolytic cocci*	:		:	1	:	2	1	:	3	4	:	2	4	
(14) Motile curved rods*	:	2	:		1	3	4	8	:	16	6	13	4	11

\* This indicates organisms common to adult animals.

